Advanced Active Remote Sensing
Geography 5130/6130
Fall 2023

Instructor: Dr. Richard R. Forster (Rick)
Time and place: Tuesday., Thursday. 9:10 AM to 10:30 AM (GC 1825)
Office Hours: Immediately after class for 1.5 hrs. or by appointment GC 3725
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Reference material: Digital text and figures of lecture material, videos, example remote sensing applications from journal papers and webpages
Evaluation: Mid term 35%, Project 55% (Proposal 5%, Progress report 10%, Presentation 15%, Paper 25%), Classroom participation 10%

General Description:

This course builds on the remote sensing fundamentals presented in Geog 3110 and the image processing analysis/interpretation skills obtained in Geog 5110/6110. (An adequate background may also be obtained through prior remote sensing experience). Active remote sensing uses radar or laser energy emitted by satellites or aircraft to measure and image the Earth's surface. Synthetic aperture radar (SAR) and lidar remote sensing permit precise measurement of surface height and changes in surfaces over time, enabling diverse applications such as glacier movement, ground displacement, and forest biomass. SAR also offers images of the earth's surface that provide information not available with traditional visible and infrared satellite sensors and the ability to image through clouds and darkness. This course covers theory and applications of active remote sensing using a combination of lectures and project-based learning.

Learning Objectives:

1. To understand the principals involved in the acquisition of remote sensing data using some of the latest sensor technology.
2. To utilize advanced image processing techniques as they apply to analysis of remote sensing images.
3. To become familiar with science applications of these data sets and analysis techniques.
4. To select the appropriate remote sensing data set(s) and image processing technique(s) for the corresponding science application.
5. To be able to answer scientific questions based on results of remote sensing and image processing analysis.

Lecture Topics:

1. Review of remote sensing basics
    - 1.1 Principals of remote sensing
    - 1.2 Common remote sensing satellites and sensors
    - 1.3 Image processing

2. Microwave Remote Sensing
    - 2.1 Sensor types
        - 2.1.1 Passive microwave remote sensing
        - 2.1.2 Scatterometers
        - 2.1.3 Synthetic Aperture Radar (SAR)
    - 2.2 Applications
        - 2.2.1 Interferometric SAR (InSAR)
            - 2.2.1.1 Generation of digital elevation models (DEMs)
            - 2.2.1.2 Generation of displacement maps
        - 2.3.1 Earth science applications

3. LiDAR (LIght Detection And Ranging)
    - 3.1 Basics of operation
    - 3.2 Example data sets
        - 3.2.1 Airborne LiDAR (Examples from the Salt Lake Valley)
        - 3.2.2 Spaceborne LiDAR (Examples from the ICESAT)
        - 3.2.3 Ground based LiDAR

4. Introduction to computer programming for remote sensing analysis (no prior programing experience necessary)
    - 4.1 Time series analysis
    - 4.2 Feature-tracking for displacement measurements
    - 4.3 Other interests of the class

General Guidelines

1) Exams must be taken at the time specified unless a valid, documented excuse is provided **before** the date of the exam. For medically related conflicts this requires a written note from a doctor.

2) Regular class attendance is strongly recommended. Lectures are intended to supplement material in the readings. You are responsible for information provided in the lectures, as well as any announcements made in class.

3) Office hours are there to be used. These times can be used for additional instruction if you are having difficulty with the material or if you are interested in a topic and would like further information. I am also open to any suggestions or comments you have about the course; please don't wait until the end-of-semester evaluation if you have any constructive comments on the course. If you have a conflict and cannot make the posted office hours, please make an appointment for another time.

4) An "incomplete" will be given only in extreme cases when conditions beyond the student's control require an extended period of absence.

5) Extra credit work will not be accepted.

Disability Statement

The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.

Computer Support

For assistance with computing issues related to the class please see the College of Social and Behavioral Science Computing webpage (https://support.csbs.utah.edu/). Note: Selecting a priority of "Critical" will automatically send a text message to the director of computing and the entire computing staff. This level is intended only for situations when multiple users are impacted in a time sensitive situation.

Academic Honesty

t is expected that students adhere to University of Utah policies regarding academic honesty, including but not limited to refraining from cheating, plagiarizing, misrepresenting one's work, and/or inappropriately collaborating. This includes the use of generative artificial intelligence (AI) tools without citation, documentation, or authorization. Students are expected to adhere to the prescribed professional and ethical standards of the profession/discipline for which they are preparing. Any student who engages in academic dishonesty or who violates the professional and ethical standards for their profession/discipline may be subject to academic sanctions as per the University of Utah's Student Code: https://regulations.utah.edu/academics/6-410.php